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AIRBAG PRODUCTS WITH NONLINEAR TEAR SEAMS

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1 **AIRBAG PRODUCTS WITH NONLINEAR TEAR SEAMS**

2

3 **BACKGROUND OF THE INVENTION**

4 **1. The Field of the Invention**

5 The present invention relates to safety restraint devices for vehicles. More
6 specifically, the present invention relates to hidden seams designed to permit airbag
7 deployment without any evidence of the seam visible to a user.

8

9 **2. The Relevant Technology**

10 The inclusion of inflatable safety restraint devices, or airbags, is now a legal
11 requirement for many new vehicles. Airbags are typically installed in the steering wheel and
12 in the dashboard on the passenger side of a car. In the event of an accident, an accelerometer
13 within the vehicle measures the abnormal deceleration and triggers the ignition of an
14 explosive charge. Expanding gases from the charge fill the airbags, which immediately
15 inflate in front of the driver and passenger to protect them from impact against the
16 windshield.

17 During normal operation, the airbags are stowed behind covers to protect them from
18 tampering and provide a more attractive interior facade for the vehicle. Seams, or
19 deliberately weakened portions of the cover material, are included in the covers to ensure that
20 the airbags deploy properly. Seams are necessary because, if the entire cover is made
21 uniformly strong, random factors, such as manufacturing defects, in the cover will determine
22 where the airbag emerges. It is necessary to ensure that deployment occurs at the proper
23 location and time. Otherwise, a driver or passenger may not receive protection from the
24 airbags, or may even be injured by improperly inflating airbags.

25 A seam may be a gap in the cover, held shut by threads, adhesives, etc. In the
26 alternative, a seam may be constitute a line across the cover in which the material of the

1 cover is formed thinner. In any case, the seam creates an inwardly-sloping region on the
2 airbag cover. The seam may be on the inside of the cover, facing the airbag, or on the
3 outside. Some covers include an outer layer of attractive material, such as leather, vinyl, or
4 another plastic, that matches the remainder of the vehicle's interior. This layer also serves
5 to cover the seam and hide it from view.

6 Other covers are made through "single-shot" construction, i.e., a manufacturing
7 process in which only one single material is used. No cover layer is then used; rather, the
8 surface facing the vehicle interior is made into a cosmetic surface through shaping and
9 texturing. Styling lines are then typically molded into the cosmetic surface to obscure the
10 underlying seam.

11 However, prior art seams typically have at least one long, straight section. Because
12 of manufacturing methods currently used to attach the outer layer, the outer layer, if used,
13 typically form-fits to the seam, creating an indentation in the outer layer over the seam. If
14 no outer layer is used, a similar problem results because the styling line does not effectively
15 fool anyone, and the styling line itself may be unsightly. If the styling line is omitted, a user
16 may then "read through" the cosmetic surface and perceive the seam. Read through occurs
17 because deformation of the material around the seam creates a visible indentation on the
18 cosmetic surface. In many cases, the material of the seam is so thin that it is translucent to
19 a user, who may then look through the cosmetic surface to perceive the seam or even the
20 airbag inside the cover.

21 Consequently, nearly every vehicle with an airbag has a straight indentation or
22 styling line in the interior finish. Since most airbags are placed at a location where they can
23 protect a user from frontal impact, this indentation is nearly always directly in front of a
24 person, in plain view. For this reason, the steering wheel and the passenger side dashboard
25 of many vehicles prominently display a straight indentation or styling line covering the
26 airbag.

1 The visible seam is problematic for a number of reasons. It may upset the design
2 scheme of the interior material of the vehicle. Many modern vehicles utilize a smooth
3 interior design that may be disrupted by the appearance of a seam in the middle of a panel.
4 An automobile manufacturer may wish to employ curvilinear patterns on the interior finish
5 of the vehicle. When combined with the straight indentations formed by prior art seams,
6 however, such curvilinear patterns may appear incongruous and distracting.

7 Furthermore, a visible seam invites tampering by curious children and others. The
8 seam is designed to yield to opening force, so it may be fairly easily broken to expose the
9 airbag. If the airbag is tampered with, the owner may have to replace it, or may even be
10 injured if it fails to deploy in the event of an accident. Even if no break is formed in the
11 seam, the surface of the outer layer may be ruined by constant picking, poking, and
12 scratching.

13 Moreover, another danger is present in vehicles in which interior airbag seams are
14 visible. Some people form a habit of resting their hands in a certain fixed position on a
15 surface, particularly over an irregularity such as a ridge, bump, or seam. For example, a
16 driver may, while driving, subconsciously rub his or her fingers along the seam. Besides
17 damage to the interior finish of the vehicle, this may ultimately cause injury to the driver
18 when the airbag deploys. The rapid timing required to inflate an airbag before a person has
19 struck a surface in the vehicle (such as the windshield) requires that the airbags open with
20 explosive force. This will not typically injure a user situated normally in the vehicle, but
21 body parts resting too close to the airbag, such as arms and hands, will be subject to the
22 explosive force of the airbag's deployment. A user could then suffer serious injuries when
23 the airbag deploys.

24 Even when known seams is not visible, they may be easily discovered by a user by
25 simply pressing on the outer layer or cosmetic surface. In either case, if a linear seam is used
26 behind the outer layer or cosmetic surface, the pressure causes the cover to fold inward along

1 the seam, so that the seam is readily perceptible. Repeated application of pressure may even
2 break the seam. Even if a seam is not otherwise visible, it is preferable, for many reasons,
3 to ensure that it is entirely hidden from a user until the airbag deploys.

4 Accordingly, a need exists for a safety restraint device cover with a seam that will
5 not be visible to a vehicle occupant, even when no styling line is used. The indentation
6 produced by the seam is difficult to eradicate without the use of additional manufacturing
7 processes to join disparate materials or alter the shape of the seam. Consequently, a need
8 exists for a novel seam design that will not show through the outer layer, if a separate
9 material is applied, or the cosmetic surface, if a single-shot, or single material process is used
10 to form the cover. A need further exists for such a cover that is manufacturable through
11 inexpensive processes such as stamping or molding.

12 13 **BRIEF SUMMARY OF THE INVENTION**

14 The apparatus of the present invention has been developed in response to the present
15 state of the art, and in particular, in response to the problems and needs in the art that have
16 not yet been fully solved by currently available airbag covers. Consequently, the present
17 invention provides an easily manufactured airbag cover with a seam that remains hidden
18 from view.

19 In accordance with the invention as embodied and broadly described herein in the
20 preferred embodiment, a cover, including a novel seam design, is provided. The cover
21 comprises a module insertable into a corresponding opening in the vehicle. An outer layer
22 may also be applied to the module to hide the module from view. A seam may be formed
23 in an outward-facing surface of the module to permit airbag deployment. The seam
24 comprises a nonlinear portion, which includes a plurality of bends that discourage form-
25 fitting of an outer layer over the seam. The bends may exist in a variety of configurations
26 suitable for keeping the outer layer from folding into the seam. This permits the use of

1 simple manufacturing processes, such as stamping and molding, to create the seam, without
2 leaving an unsightly and potentially dangerous crease in the outer layer.

3 In the alternative, instead of the outer layer, a cosmetic surface may be formed on
4 a portion of the module facing the vehicle interior. The nonlinear seam may then be formed
5 in an inward-facing surface of the module. Such a nonlinear seam minimizes read through
6 because the material does not deform uniformly to produce a translucent line. Even if the
7 nonlinear seam does create translucent regions in the cosmetic surface, the translucent
8 regions will be nonlinear, such that there is no viewpoint from which a user may see through
9 any significant portion of the cover. There is no linear, regular feature to draw a viewer's
10 attention.

11 Additionally, whether an outer layer or cosmetic surface is used, if a user presses
12 against the cover, the cover does not deflect in such a way that the seam is easily discovered.
13 The seam extends along multiple axes so that bending does not occur only along one axis,
14 as with a linear seam. Rather, bending occurs along multiple axes, as would be expected for
15 a surface with no weakened portions. In effect, since the seam, which forms a weakened
16 region, is irregular, it will not be perceived by a user.

17 The nonlinear portion may be embodied in several different ways. For example, the
18 seam may have a few larger bends of substantially equal size, with few or no straight sections
19 between them. A larger number of smaller bends may also be used to decrease the width of
20 the nonlinear portion, while retaining the novel benefits of the bends. In the alternative, the
21 bends may have a very tight radius and simply connect linear segments in a zig-zag pattern.
22 Linear segments may also be connected by bends arranged in pairs, to create a seam with a
23 crankshaft-like appearance. Large-radius bends could even be used in combination with
24 linear segments, perhaps by arranging the bends between symmetrical linear segments.

25 The bends and linear segments, if used, need not be uniform in arrangement or
26 configuration. Any combination of the embodiments described above may be used

1 according to the invention. Any seam in which no linear portion of any linear segment of
2 any substantial length can be found is contemplated by the invention. Substantially linear
3 or nonlinear side portions of the seam may also be provided to enlarge the size of the
4 opening through which the airbag will deploy. Additionally, the seam need not follow a
5 generally linear course, but may be generally circular, semicircular, polygonal, or otherwise
6 in its overall shape.

7 In operation, expanding gases fill the airbag, and the airbag bursts through the seam.
8 Openings may form at one end of the seam and propagate rapidly from there to the other end,
9 or all parts of the seam may burst open simultaneously. If an outer layer is used, it may
10 break open in similar fashion. In any case, despite the irregular shape of the seam, it will still
11 open reliably as long as the seam is properly constructed, because the force tending to pull
12 the seam apart will remain substantially the same as with a straight seam. The fact that the
13 airbag deploys through a nonlinear opening will not substantially hinder its operation.

14 The seam of the present invention has application not only to driver and passenger
15 side airbags, but also to other vehicle airbags. For example, side mounted airbags designed
16 to protect occupants of a vehicle from lateral impact may utilize nonlinear tear seams to
17 ensure that the lateral surfaces of the vehicle, such as doors, armrests, and side ceiling
18 portions, do not show a seam or styling line where the airbag deploys. Similarly, airbags
19 used to protect a vehicle occupant's legs may have a nonlinear tear seam hidden from view.

20 Thus, the current invention provides a novel, nonlinear seam for an airbag cover.
21 If an outer layer is used, the nonlinear seam resists form-fitting of the outer layer over the
22 seam by providing a number of bends into which the outer layer cannot easily fit. As a
23 result, the outer layer maintains a much more attractive appearance and does not create a
24 temptation for a person to tamper with the seam, or to maintain any body part in dangerously
25 close proximity to the seam during operation of the vehicle.

26

1 Where a cosmetic surface is formed instead of the outer layer, the nonlinear seam
2 prevents read through of the thinner material of the seam, and thus obviates any styling line
3 used to hide the seam from view. The danger that a user will discover the seam and possibly
4 even break open the cover by pressing on the outer layer or the cosmetic surface is further
5 reduced. Hence, the seam of the present invention makes a vehicle safer, more attractive,
6 and more wear-resistant than previously known seams.

7 These and other features and advantages of the present invention will become more
8 fully apparent from the following description and appended claims, or may be learned by the
9 practice of the invention as set forth hereinafter.

10 11 BRIEF DESCRIPTION OF THE DRAWINGS

12 In order that the manner in which the above-recited and other advantages and objects
13 of the invention are obtained will be readily understood, a more particular description of the
14 invention briefly described above will be rendered by reference to specific embodiments
15 thereof which are illustrated in the appended drawings. Understanding that these drawings
16 depict only typical embodiments of the invention and are not therefore to be considered to
17 be limiting of its scope, the invention will be described and explained with additional
18 specificity and detail through the use of the accompanying drawings in which:

19 Figure 1 is an exploded view of a safety restraint device cover, including a module
20 with a seam having a nonlinear portion, according to the invention;

21 Figure 2 is a plan view of an alternative embodiment of a seam having a higher
22 number of bends;

23 Figure 3 is a plan view of another alternative embodiment of a seam having pointed
24 bends;

Figure 4 is a plan view of another alternative embodiment of a seam having a pairs of bends, the pairs oriented in consecutively opposite directions and separated by linear segments;

Figure 5 is a plan view of another alternative embodiment of the seam having linear segments disposed on either side of the bends;

Figure 6 is a plan view of another alternative embodiment of the seam having a mix of bends of different sizes and shapes intermingled with linear segments; and

Figure 7 is a perspective view of the safety restraint device cover of Figure 1 with an outer layer attached, concealing the seam.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

The presently preferred embodiments of the present invention will be best understood by reference to the drawings, wherein like parts are designated by like numerals throughout. It will be readily understood that the components of the present invention, as generally described and illustrated in the figures herein, could be arranged and designed in a wide variety of different configurations. Thus, the following more detailed description of the embodiments of the apparatus, system, and method of the present invention, as represented in figures 1 through 6, is not intended to limit the scope of the invention, as claimed, but is merely representative of presently preferred embodiments of the invention.

As alluded to previously, airbags have become a great lifesaving tool for the automotive industry. For cosmetic and safety purposes, the airbags must be concealed underneath some type of solid, opaque cover after installation in a vehicle. Seams in the cover are necessary to ensure that the airbag inflates uniformly and through the correct part of the cover.

An outer layer may be applied to the cover to match the interior of the vehicle. However, known outer layers bend and fold to form-fit to the seam, thereby creating an

1 unsightly, distracting, and even potentially dangerous indentation over the airbag. The outer
2 layer may also be omitted in favor of single-shot construction, in which the cover is made
3 from a single piece of material. With a single-shot cover, the seam is typically formed inside
4 the cover. However, the seam may still be "read through" the cover, due to deflection the
5 regions surrounding the seam and the translucent nature of many thinly-constructed plastics.

6 The present invention makes novel use of principles of material deformation to
7 avoid the problems of the prior art. More specifically, a flat object bends far more readily
8 than a bent or creased object. This is because bending is easiest along thin cross sections,
9 and a bent or folded object has no thin cross section along which bending can easily occur.
10 For example, houses with peaked roofs can bear far heavier loads than houses with flat roofs.
11 Similarly, steel beams with an "I" shape are commonly used in construction because they
12 withstand bending far more effectively than flat beams, without the expense and weight of
13 a solid mass. In effect, an object that has already been bent or folded is somewhat thick
14 along any cross section, and therefore is much more difficult to bend in a second direction.

15 The same principle applies to objects that have not yet been bent or folded. When
16 an object is under multiple bending forces, each force limits the degree to which the other
17 force can bend the object because bending in one direction increases the thickness of the
18 object against bending in the other direction. As a result, the object may bend only slightly
19 in all directions.

20 The current invention applies this principle to a seam for an airbag cover. Straight
21 seams, like those of the prior art, will support the outer layer against bending in all directions
22 except for one, so the outer layer will bend in the unsupported direction to fold into the seam.
23 The present invention provides a meandering seam, so that the outer layer is supported
24 against bending in all directions. Some bending may occur in all directions, but that bending
25 is so minor as to be invisible to the naked eye. Additionally, small-scale, multi-directional
26

1 bending precludes further bending in all directions. The operation of this principle is further
2 illustrated in the following figures and their accompanying descriptions.

3 Referring to Figure 1, one possible embodiment of a cover 10 according to the
4 invention is shown. A module 12 is designed to be installed in an interior compartment (not
5 shown) of a vehicle. The module 12 has a peripheral surface 14, shaped to properly fit
6 against a mating surface in the vehicle, and a face portion 15 with an exterior side 16 facing
7 the seat of a vehicle occupant. A skirt 17 is attached to the face portion 15 or the peripheral
8 surface 14, and carries a series of locking tabs 18 designed to deform into locking
9 engagement with corresponding structures in the interior compartment of the vehicle.

10 The module 12 may be integrally formed from any suitable material, including
11 polymers, metals, ceramics, and composites. Alternatively, the various components of the
12 module 12, including the peripheral surface 14, the face portion 15, the and the skirt 17, may
13 be made from different materials assembled through means known in the art. The face
14 portion 15 and skirt 17 are preferably made of an elastomeric, deformable material such as
15 plastic. An airbag (not shown) may be attached to and installed with the module 12, or may
16 be installed within the interior compartment before installation of the cover 10.

17 A seam 20 is formed in the face portion 15 to permit deployment of the airbag
18 through the face portion 15. The seam 20 may take many forms, including an incision clear
19 through the face portion 15 held shut by sewn fibers, adhesives, welds, deformable locking
20 members, or other retention mechanisms known in the art. Alternatively, the seam 20 may
21 be simply a region in which the face portion 15 is made thinner than in the surrounding
22 regions, so that the seam 20 is the first portion to separate under stress. In such a
23 configuration, the material of the face portion 15 may slope inward from the exterior side 16
24 to create a seam 20 in the form of a trough. The seam 20 is not limited to the forms disclosed
25 herein, but includes any thin structure made to create an opening in a surface under stress.

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1 The seam 20 includes a nonlinear portion 21, which is preferably centrally located
2 on the face portion 15. For the purposes of this application, "nonlinear" refers to any narrow
3 structure extending along a path from one end of the structure to the other, wherein the path
4 is not a straight line. Conversely, "linear" refers to narrow structures extending along a
5 straight line from one end of the structure to the other. Accordingly, a nonlinear object may
6 include linear segments if the overall path followed by the nonlinear object is not a straight
7 line. The nonlinear portion 21 satisfies this nonlinearity requirement because the path
8 followed by the nonlinear portion 21 between first and second ends 22 and 23 of the
9 nonlinear portion 21 is not a straight line.

10 The seam 20 preferably also includes a first side portion 24 attached to the first end
11 22 of the nonlinear portion 21, and a second side portion 25 attached to the second end 23
12 of the nonlinear portion 21. The first and second side portions 24 and 25 are oriented
13 generally perpendicular to the general orientation of the nonlinear portion 21 (a straight path
14 between the first and second ends 22 and 23). The side portions 24, 25 enlarge the size of
15 the opening formed when the airbag deploys, to permit more rapid and reliable deployment.

16 The nonlinear portion 21 includes a number of bends 26 that create a meandering
17 path between the first and second ends 22 and 23. According to this embodiment, the bends
18 26 are rounded. However, "bend" within this application is any feature in the nonlinear
19 portion 21 that changes the path along the nonlinear portion 21 between the first and second
20 ends 22, 23 in a clockwise or counterclockwise direction. Consequently, sharp turns as well
21 as curves of any radius constitute "bends."

22 An outer layer 30 may be attached to the exterior side 16 of the face portion 15 by
23 a means known in the art, including but not limited to chemical and adhesive bonding, heat
24 welding, RF welding, interference fitting, deformable locking members, and heat shrinking.
25 The outer layer 30 may be made from any suitable material, including polymers, metals,
26 ceramics, and composites. However, it is desirable that the outer layer 30 be attractive,

1 inexpensive, and weak enough to tear or detach from the exterior side 16 of the face portion
2 15 to permit deployment of the airbag. The outer layer 30 should also match the interior trim
3 of the vehicle. Consequently, plastics or other materials used in the vehicle interior are
4 preferred.

5 The ability of the outer layer 30 to form fit to the seam 20 is dependent upon the
6 stiffness of the material forming the outer layer 30, the thickness of the outer layer 30, and
7 the geometry of the seam 20. A thinner, more flexible outer layer 30 will more easily
8 conform to the shape of the seam 20. In order to permit deployment of the airbag, the outer
9 layer 30 must be substantially thin and flexible. Thus, the geometry of the seam 20 is the
10 critical factor in determining whether the seam 20 shows through the outer layer 30.

11 Linear deformation, in the form of a straight crease or bend in the outer layer 30,
12 readily occurs because deformation develops only along a thin cross-sectional area. When
13 the outer layer 30 is deformed in one direction, an intersecting deformation is much more
14 difficult to form because the first deformation effectively increases the thickness, and thereby
15 the sectional modulus, of the outer layer 30 along the line of the first deformation.
16 Consequently, existing deformations in the outer layer 30 make the outer layer 30 effectively
17 stiffer and more resistant to further deformation.

18 The bends 26 in the nonlinear portion 21 are critical for that reason. By constantly
19 changing the direction in which the outer layer 30 would have to deform to conform with the
20 seam 21, the bends 26 do not enable the outer layer 30 to significantly deform in any
21 direction. As a result, the outer layer 30 remains substantially flat, with a cavity between the
22 seam 20 and the outer layer 30, and the seam 20 is not visible to a passenger looking at the
23 outer layer 30. This effect will occur with any configuration of the seam 20 in which no
24 linear or near-linear trough lies underneath the outer layer 30. The curved bends 26 of this
25 embodiment are especially effective because there is no straight line of any length in the
26 nonlinear portion to which the outer layer 30 can conform itself. Depending on aesthetic and

1 material considerations, the first side portion 24 and the second side portion 25 may be
2 linear. The side portions 24, 25 may also be made nonlinear with a shape similar to that of
3 the nonlinear portion 21.

4 If desired, the outer layer 30 may also be omitted entirely, and the module 12 may
5 be constructed of a "single-shot" material. Single-shot processing is simply a fabrication
6 process, such as injection molding, that utilizes only a single material, and preferably one
7 single process. The exterior side 16 of the module 12 may be specially formed, through
8 texturing, aesthetic shaping, and the like, to create a cosmetic surface 16.

9 If no outer layer 30 is used, the seam 20 is preferably formed on the inside of the
10 module 12, i.e., on the interior side of the face portion 15 (not visible in Figure 1). The seam
11 20 may otherwise be configured as described above, with a nonlinear portion 21. The
12 nonlinear portion 21 then prevents read through because there is no viewpoint from which
13 a user may see through any substantial part of the seam 20. A user perceives no significant
14 unnatural variation in the cosmetic surface 16. Thus, no styling line need be formed in the
15 exterior side 16.

16 Additionally, whether the outer layer 30 is used, or the exterior side 16 is rather
17 made into a cosmetic surface 16, pressure applied against the face portion 15 of the cover 10
18 by a user does not bend the face portion 15 along any single axis. The seam 20 presents a
19 large variety of weakened bending axes, so that the face portion 15 bends inward in several
20 directions when pressure is applied. The seam 20 thus remains imperceptible to a user, and
21 a user has no reason to repeatedly exert any considerable pressure against the face portion
22 15.

23 Referring to Figure 2, an alternative embodiment of the seam 20 is presented. In this
24 embodiment, the nonlinear portion 21 has a multiplicity of smaller bends 36 to decrease the
25 width of the nonlinear portion. Smaller bends 36 may provide additional support for
26 especially flexible, thin materials that may be used in the outer layer 30. As with the

Referring to Figure 6, yet another alternative embodiment is depicted. The nonlinear portion 21 of the seam 20 may include a mixture of bends 60 and linear segments 62 of various shapes and sizes. The seam 20 need not be precisely formed, and will not show

1 through the outer layer 30 as long as the requisite nonlinear features are found. The bends
2 60 may also be distributed asymmetrically along the seam 20.

3 Referring to Figure 7, the cover 10 of the present invention is shown with the seam
4 20 hidden. If an outer layer 30 is used, it has been attached to the exterior side 16 of the
5 cover 10, as depicted in Figure 7. The outer layer 30 may be installed by any known method,
6 including but not limited to adhesive bonding, chemical bonding, heat bonding, vacuum
7 forming, RF welding, mechanical fastening, swaging, and sewing. The outer layer 30 shows
8 little or no sign of the seam 20 because the outer layer 30 is not form-fitted to the seam 20.

9 However, if no outer layer 30 has been used, the exterior side 16 is simply formed
10 as a cosmetic surface 16. In such a case, the cover 10 appears as shown in Figure 7, except
11 that no outer layer 30 is present. The seam 20 is substantially invisible, even though there
12 is no styling line on the cosmetic surface 16, because the seam 20 is nonlinear and therefore
13 prevents read through. Similarly, any deformation that occurs in the cosmetic surface due
14 to the seam 20 is also relatively unobservable.

15 Thus, the cover 10 is ready for installation in a vehicle. The locking tabs 18 may
16 be aligned with suitable receptacles in the vehicle so that the cover 10 is held firmly within
17 the vehicle. The outer layer 30, if present, appears simply as a panel; any designs be formed
18 on the panel before or after installation in the vehicle without the interference of the seam
19 20.

20 Accordingly, the principles of material deformation are effectively applied by the
21 present invention. The meandering nature of the seam 20 ensures that there is no single axis
22 along which the outer layer 30 can visibly bend. As a result, the seam 20 is effectively
23 hidden, and will not interfere with design schemes for the vehicle interior. Furthermore,
24 occupants of the vehicle are not drawn to damage the outer layer 30 over the seam or keep
25 their arms and hands in dangerous proximity to the airbag. Thus, the novel seam 20 of the
26

1 present invention keeps the outer layer 30 flat, thereby making the entire cover 10 for an
2 airbag more attractive, hassle-free, and safe.

3 The present invention may be embodied in other specific forms without departing
4 from its structures, methods, or other essential characteristics as broadly described herein and
5 claimed hereinafter. The described embodiments are to be considered in all respects only as
6 illustrative, and not restrictive. The scope of the invention is, therefore, indicated by the
7 appended claims, rather than by the foregoing description. All changes that come within the
8 meaning and range of equivalency of the claims are to be embraced within their scope.

9 What is claimed and desired to be secured by United States Letters Patent is: